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# MEMORANDUM

TO: Ms. Victoria Whitney, State Water Resources Control Board,
Division of Water Rights

FROM: David P. Lounsbury, P.E.
James C. Hanson Consulting Civil Engineers

DATE: May 31, 2007

RE: **Required Analysis and Calculations for Water Right Application by Brooktrails Township Community Services District**

The purpose of this memorandum is to summarize the results of the analysis and calculations for the above referenced application. The calculations are performed for the diversion period October 1 through March 31, with demand calculated for the same period. The Points of Interest (POI) analyzed for this project were identified by the applicant and are described below. The points are labeled POI Nos. 1, 3, 4 and 5 and are located within the Outlet Creek watershed tributary to the Upper Eel River.

**Locations of Points of Interest**

| POI No. | Location |
|---|---|
| 1 | Lake Emily |
| 3 | Willits Creek immediately above the confluence with Mill Creek |
| 4 | Mill Creek immediately above the confluence with Outlet Creek |
| 5 | Outlet Creek immediately above the confluence with the Upper Eel River |

The objectives of the analysis are as follows:

- To determine whether water is available for appropriation in accordance with California Water Code section 1260 (k); and
- To estimate the impact of the diversions sought on streamflows and the potential resulting impacts to fishery resources.

## PROJECT DESCRIPTION

The project is located in Mendocino County, and is situated about 2 miles northwest of the City of Willits, to the west of Highway 101. The place of use described by the application is a housing and golf course development of approximately 8,400 acres. Approximately 1,500 of the planned 5,800 homes have been built thus far and are served with water stored in two existing reservoirs referred to herein as Lake Emily and Lake Ada Rose (see attached map). The applicant has storage rights for Lake Emily under Permit 15913 (Application 23038) and for Lake Ada Rose under Permit 14218 (Application 21275) authorizing 270 af and 138 af of onstream storage, respectively. The applicant is hereby filing an application for storage of additional water in Lake Emily to ensure that the water resources required to support the municipality are sufficient for the existing and proposed population.

This application seeks the right to divert water from Willits Creek tributary to Mill Creek thence Outlet Creek thence the Eel River at the point of diversion (POD) referred to herein as POD No. 1 for storage in Lake Emily. Water will be diverted to storage from October 1 through March 31 of the following year for irrigation, domestic, recreation and municipal uses. The total amount of water to be diverted to storage under this application is 285 af per annum.

Lake Emily has a permitted capacity of 270 af under Permit 15913 (Application 23038). Permit 15913 also authorizes 30 af of storage in the abandoned South Lake Reservoir. A Petition for Change in Distribution of Storage (Petition) has been submitted requesting permission to store the 30 af authorized for storage in the former South Lake Reservoir in Lake Emily. Lake Emily will be enlarged to a capacity of 585 af to accommodate the existing 270 af authorized under Permit 15913, the 30 af requested by the Petition, and the additional 285 af requested under this application (270 + 30 + 285 = 585).

## ESTIMATED SEASONAL UNIMPAIRED FLOW

Unimpaired flow during the project's diversion season is the total volume of water, on average, that would flow past a selected point of interest on a seasonal basis if no diversions (impairments) were taking place in the watershed above that point.

The seasonal unimpaired flows around this project are estimated by correlating the gaged stream flows at USGS Gaging Station No. 11472160, Willits Creek above Lake Emily (Willits Creek gage) and USGS Gaging Station No. 11472200, Outlet Creek near Longvale (Outlet Creek gage) to the watersheds tributary to the POIs. The Willits Creek gage is located on Willits Creek about 1,500 feet above Lake Emily and has records available from water years 2004 through 2007 (see attached Table 5). The Outlet Creek gage is located about 4,000 feet above the confluence with the Upper Eel River and has records available from water years 1957 through 1994 (see attached Table 6).

To evaluate the seasonal flows recorded at the Willits Creek gage, we reviewed the precipitation records obtained from National Oceanic and Atmospheric Administration (NOAA) gage Willits NE1, located about two miles south east of the project site. We computed the seasonal precipitation amounts during the period of record of the Willits Creek stream gage and the Willits NE1 precipitation gage to determine the relation of the short period of record to the long-term average. The Willits precipitation gage has a period of record of 47 years, from 1960 to 2007, and a long-term seasonal average of 43.62 inches (see attached Table 7). The seasonal precipitation during the period of record of the Willits Creek stream gage (2004-2007) is 43.98 inches, which is 101% of the long-term seasonal average. Following the assumption that the run off and stream flow for the period of record of the Willits Creek stream gage would also be near average, we determined that it is appropriate to use the average of the seasonal flows measured at the Willits Creek gage as the estimated seasonal unimpaired flow.

The seasonal flows recorded at the Outlet Creek gage are taken to represent the long term average without adjustment due to the relatively long period of record of flows available. The estimated seasonal unimpaired flow (estimated seasonal flow) during the diversion season of October 1 through March 31 as measured at each gage is as follows:

| Location | Total (af) |
|---|---|
| Willits Creek Gage | 5,358 |
| Outlet Creek Gage | 150,777 |

The estimated seasonal streamflow at POI Nos. 1, 3, and 4 is estimated by adjusting the Willits Creek gage data for differences in drainage area. Based on the proximity and topographical similarities of the Willits Creek gage to the watersheds for POI Nos. 1, 3, and 4, we determined that no adjustment of gage records to account for differences in precipitation is necessary. The estimated seasonal flow for POI No. 5 is taken directly from the Outlet Creek gage records with no adjustments for drainage area or precipitation. The watershed areas for the Willits Creek gage and Outlet Creek gage sites are as follows:

| Location | Watershed Area (ac) |
|---|---|
| Willits Creek Gage | 2,364 |
| Outlet Creek Gage | 103,657 |

The tributary drainage areas for each watershed are shown on the attached map. Watersheds were delineated on digital USGS 7.5 minute quad maps, with watershed areas determined using AutoCad. Flows from the watershed areas tributary to the POIs were estimated using the following formula:

$$Q_2 = Q_1 \times (A_2 / A_1)$$

Where:

$Q_2$ = Flow at point of interest on tributary watershed;
$Q_1$ = Flow at the gage;
$A_2$ = Watershed area above point of interest;
$A_1$ = Watershed area above gage;

The tributary drainage area and estimated seasonal unimpaired flows for the watershed above each POI are summarized on attached Table 8.

## WATER RIGHTS OF RECORD

The total face value of recorded water rights within the Outlet Creek watershed for the period of October 1 to March 31 were tabulated based on the SWRCB's stream code database, the SWRCB's WRIMS database, and review of selected water right files. Recorded water rights within each watershed are shown on the attached Tables 1 - 4. The last column of each table is a running cumulative total of all rights of record within the watershed. For purposes of accumulating diversions, it has been assumed that all statements of diversion and use have priority over appropriative rights. Footnotes on each table disclose assumptions made when deviating from face value for certain filings.

## CUMULATIVE FLOW IMPAIRMENT INDEX

The Cumulative Flow Impairment Index (CFII) is computed by dividing the total face value of water rights of record for the period of October 1 through March 31 by the estimated seasonal unimpaired flow for the period of October 1 through March 31. Based on the forgoing calculations, CFII values computed for each watershed are shown on the attached Table 8.

The foregoing CFIIs are likely conservative for the following reasons:

1. Use of the full face value of water rights overestimates impairment. The full face value of each water right is not diverted each and every year.

2. Claims of all rights shown on Tables 1 through 4 have not been verified as valid.

3. No adjustment of Outlet Creek or Willits Creek gage data were made for flow impairment during the period of record, therefore the gaged flow underestimates unimpaired flow resulting in an overestimation of CFII.

We trust the foregoing satisfactorily addresses the issue of water available within the stream system affected by the pending application.

c.c Mike Chapman
BTRLE.007

**TABLE 5**

**USGS Gaging Station No. 11472160,**
**"Willits Creek above Lake Emily" Flow Data**
**October 1 - March 31 Diversion Season Flows**
**(all amounts in acre-feet)**

| Water Year | Oct | Nov | Dec | Jan | Feb | Mar | Diversion Season Total |
|---|---|---|---|---|---|---|---|
| 2004 | 1 | 28 | 1,408 | 1,090 | 2,050 | 542 | 5,120 |
| 2005 | 23 | 21 | 591 | 856 | 424 | 1,426 | 3,341 |
| 2006 | 14 | 90 | 3,811 | 2,759 | 1,412 | 2,813 | 10,899 |
| 2007 | 2 | 50 | 411 | 269 | 823 | 517 | 2,072 |
| | | | **Period of Record Average for Diversion Season Only:** | | | | **5,358** |

# TABLE 6

## USGS Gage No. 11472200
## "Outlet Creek Near Longvale" Flow Data
## October 1 - March 31 Diversion Season Flows
## (all amounts in acre-feet)

| Water Year | Oct | Nov | Dec | Jan | Feb | Mar | Diversion Season Total |
|---|---|---|---|---|---|---|---|
| 1956-57 | 5,625 | 2,398 | 1,946 | 34,654 | 63,135 | 69,807 | 177,565 |
| 58 | 512 | 95 | 633 | 26,145 | 30,679 | 66,013 | 124,076 |
| 59 | 79,624 | 3,614 | 1,936 | 374 | 92 | 89 | 85,728 |
| 1959-60 | 74,544 | 77,255 | 13,127 | 8,029 | 1,486 | 423 | 174,864 |
| 61 | 110 | 137 | 898 | 21,900 | 154,521 | 68,520 | 246,086 |
| 62 | 408 | 121 | 72 | 133 | 9,857 | 62,667 | 73,257 |
| 63 | 17,637 | 13,587 | 2,464 | 430 | 110 | 109 | 34,337 |
| 64 | 24,746 | 85,737 | 59,255 | 6,387 | 2,303 | 581 | 179,009 |
| 1964-65 | 33,788 | 1,991 | 65,154 | 4,616 | 89,273 | 11,695 | 206,517 |
| 66 | 575 | 167 | 136 | 673 | 43,063 | 21,930 | 66,543 |
| 67 | 6,532 | 2,465 | 940 | 206 | 62 | 45 | 10,250 |
| 68 | 239,916 | 30,044 | 6,048 | 38,244 | 6,510 | 1,291 | 322,053 |
| 69 | 94 | 7,600 | 12,915 | 144,133 | 37,427 | 42,090 | 244,258 |
| 1969-70 | 265 | 52 | 52 | 91 | 11,480 | 76,075 | 88,015 |
| 71 | 63,151 | 14,618 | 2,398 | 437 | 103 | 16 | 80,723 |
| 72 | 54,076 | 48,443 | 60,417 | 9,090 | 1,686 | 929 | 174,642 |
| 73 | 228 | 2,076 | 48,522 | 195,662 | 131,800 | 51,492 | 429,780 |
| 74 | 417 | 89 | 55 | 292 | 783 | 24,209 | 25,845 |
| 1974-75 | 5,056 | 2,122 | 700 | 252 | 76 | 65 | 8,272 |
| 76 | 98,887 | 28,664 | 40,765 | 59,638 | 7,835 | 2,031 | 237,820 |
| 77 | 164 | 892 | 20,716 | 19,339 | 55,246 | 66,176 | 162,533 |
| 78 | 296 | 107 | 91 | 1,014 | 11,669 | 13,490 | 26,666 |
| 79 | 25,553 | 3,322 | 873 | 232 | 61 | 44 | 30,085 |
| 1979-80 | 74,306 | 120,131 | 88,972 | 120,472 | 6,266 | 1,404 | 411,550 |
| 81 | 93 | 527 | 9,009 | 46,178 | 80,274 | 86,268 | 222,350 |
| 82 | 514 | 170 | 126 | 180 | 3,820 | 17,861 | 22,671 |
| 83 | 19,169 | 6,889 | 1,107 | 333 | 83 | 219 | 27,799 |
| 84 | 1,161 | 977 | 4,973 | 6,873 | 735 | 443 | 15,162 |
| 1984-85 | 202 | 1,798 | 14,450 | 130,399 | 132,551 | 73,747 | 353,147 |
| 86 | 639 | 140 | 194 | 161 | 104 | 453 | 1,691 |
| 87 | 20,777 | 17,740 | 4,114 | 472 | 94 | 58 | 43,256 |
| 88 | 39,724 | 102,200 | 98,766 | 28,217 | 8,118 | 2,233 | 279,259 |
| 89 | 57 | 206 | 18,536 | 6,809 | 56,877 | 38,305 | 120,790 |
| 1989-90 | 259 | 29 | 7 | 105 | 3,536 | 61,208 | 65,144 |
| 91 | 85,897 | 49,385 | 3,312 | 548 | 142 | 95 | 139,380 |
| 92 | 95,817 | 121,886 | 114,190 | 138,914 | 33,898 | 7,486 | 512,191 |
| 93 | 191 | 407 | 57,135 | 103,219 | 8,283 | 43,084 | 212,319 |
| 94 | 990 | 158 | 94 | 83 | 5,292 | 87,292 | 93,909 |
| | | | **Period of Record Average for Diversion Season Only:** | | | | **150,777** |

# TABLE 7

## Willits 1 NE Precipitation Station
## Monthly Precipitation Data
## Diversion Season October 1 - March 31

(all amounts in Inches)

| Water Year | Oct | Nov | Dec | Jan | Feb | Mar | Total | Percent of Average |
|---|---|---|---|---|---|---|---|---|
| 1960-61 | 1.22 | 8.89 | 8.46 | 5.38 | 8.17 | 10.07 | 42.19 | 96.7% |
| 62 | 2.10 | 9.00 | 5.07 | 3.99 | 11.60 | 7.53 | 39.29 | 90.1% |
| 63 | 11.36 | 5.17 | 6.56 | 6.89 | 4.70 | 7.92 | 42.60 | 97.7% |
| 64 | 4.59 | 12.82 | 2.75 | 10.36 | 0.69 | 4.88 | 36.09 | 82.7% |
| 1964-65 | 1.68 | 12.78 | 31.41 | 10.23 | 1.92 | 2.66 | 60.68 | 139.1% |
| 66 | 0.83 | 10.94 | 6.32 | 12.73 | 5.89 | 3.90 | 40.61 | 93.1% |
| 67 | 0.05 | 11.18 | 8.28 | 14.08 | 0.98 | 10.05 | 44.62 | 102.3% |
| 68 | 3.76 | 4.04 | 7.02 | 10.75 | 7.07 | 5.86 | 38.50 | 88.3% |
| 69 | 2.29 | 5.45 | 20.89 | 22.79 | 12.20 | 2.37 | 65.99 | 151.3% |
| 1969-70 | 3.39 | 1.82 | 15.05 | 26.05 | 5.50 | 2.65 | 54.46 | 124.8% |
| 71 | 3.79 | 12.18 | 14.51 | 10.29 | 1.09 | 11.44 | 53.30 | 122.2% |
| 72 | 0.86 | 6.17 | 8.31 | 7.22 | 6.83 | 3.69 | 33.08 | 75.8% |
| 73 | 2.54 | 7.31 | 10.69 | 16.69 | 7.87 | 5.63 | 50.73 | 116.3% |
| 74 | 5.69 | 18.99 | 9.87 | 13.17 | 8.22 | 14.28 | 70.22 | 161.0% |
| 1974-75 | 2.62 | 2.10 | 7.01 | 8.18 | 14.82 | 18.43 | 53.16 | 121.9% |
| 76 | 6.41 | 3.53 | 4.21 | 1.28 | 9.76 | 1.99 | 27.18 | 62.3% |
| 77 | -- | -- | -- | -- | -- | -- | -- | -- |
| 78 | 1.79 | 6.13 | 13.30 | 16.25 | 10.62 | 7.62 | 55.71 | 127.7% |
| 79 | 0.00 | 1.89 | 1.17 | 10.27 | 12.66 | 3.61 | 29.60 | 67.9% |
| 1979-80 | 6.85 | 10.35 | 7.07 | 10.27 | 10.83 | 3.98 | 49.35 | 113.1% |
| 81 | 1.90 | 1.91 | 8.78 | 10.41 | 5.15 | 5.29 | 33.44 | 76.7% |
| 82 | 6.03 | 15.62 | 16.28 | 6.92 | 8.56 | 10.70 | 64.11 | 147.0% |
| 83 | 6.08 | 13.78 | 11.96 | 11.58 | 16.96 | 17.25 | 77.61 | 177.9% |
| 84 | 1.47 | 19.18 | 16.27 | 0.83 | 6.63 | 3.66 | 48.04 | 110.1% |
| 1984-85 | 4.73 | 17.22 | 1.63 | 1.29 | 4.90 | 6.46 | 36.23 | 83.0% |
| 86 | 3.16 | 7.43 | 5.17 | 11.06 | 21.62 | 9.21 | 57.65 | 132.2% |
| 87 | 1.69 | 1.09 | 4.26 | 8.22 | 7.13 | 9.36 | 31.75 | 72.8% |
| 88 | 2.52 | 5.64 | 13.42 | 8.86 | 0.23 | -- | 30.67 | 70.3% |
| 89 | 0.30 | -- | 6.09 | 3.70 | 1.38 | -- | 11.47 | 26.3% |
| 1989-90 | 2.55 | 2.00 | 0.18 | -- | 4.82 | 3.37 | 12.92 | 29.6% |
| 91 | 1.45 | 0.75 | 2.12 | 1.65 | 4.40 | 14.52 | 24.89 | 57.1% |
| 92 | 2.78 | 3.35 | 4.01 | 4.69 | 12.10 | 4.79 | 31.72 | 72.7% |
| 93 | 4.97 | 1.83 | 14.59 | 13.46 | 7.99 | 4.86 | 47.70 | 109.3% |
| 94 | 1.13 | 2.13 | 6.97 | 6.32 | 7.06 | 0.69 | 24.30 | 55.7% |

## TABLE 7 - CONTINUED

**Willits 1 NE Precipitation Station**
**Monthly Precipitation Data**
**Diversion Season October 1 - March 31**
**(all amounts in Inches)**

| Water Year | Oct | Nov | Dec | Jan | Feb | Mar | Total | Percent of Average |
|---|---|---|---|---|---|---|---|---|
| 1994-95 | 0.42 | 8.19 | 6.54 | 28.36 | 2.24 | 18.93 | 64.68 | 148.3% |
| 96 | 0.00 | 0.76 | 17.24 | 18.42 | 11.74 | 4.83 | 52.99 | 121.5% |
| 97 | 2.29 | 5.50 | 25.17 | 11.14 | 2.33 | 1.66 | 48.09 | 110.2% |
| 98 | 3.49 | 8.11 | 3.62 | 23.83 | -- | 9.10 | 48.15 | 110.4% |
| 99 | 2.23 | 11.13 | 4.35 | 7.15 | 18.08 | 7.73 | 50.67 | 116.2% |
| 1999-2000 | 2.10 | 8.18 | 1.38 | 10.79 | 12.88 | 2.70 | 38.03 | 87.2% |
| 01 | 4.94 | 1.63 | 2.67 | 7.25 | 8.91 | 3.49 | 28.89 | 66.2% |
| 02 | 1.11 | 14.56 | -- | 6.68 | 4.95 | 4.08 | 31.38 | 71.9% |
| 03 | 0.00 | 6.02 | 26.11 | 6.22 | 3.03 | 6.69 | 48.07 | 110.2% |
| 04 | 0.00 | 6.20 | 18.81 | 4.52 | 12.24 | 2.29 | 44.06 | 101.0% |
| 2004-05 | 4.48 | 1.21 | 11.36 | 7.13 | 3.98 | 9.52 | 37.68 | 86.4% |
| 06 | 1.63 | 7.21* | 24.29 | 11.55 | 6.95 | 13.06 | 64.69 | 148.3% |
| 07 | 0.29 | 6.38 | 9.70 | 1.03 | 10.96 | 1.12 | 29.48 | 67.6% |
| **Period of Record Average for Diversion Season Only:** | | | | | | | **43.62** | |
| **Average Precipitation for 2004 - 2007:** | | | | | | | **43.98** | 100.8% |

*Monthly precipitation for Nov. 2005 not recorded at Willits gage. Value taken from nearby NOAA Station No. 47109 "Potter Valley P H"

## TABLE 8

### Water Availability and Cumulative Flow Impairment Index Calculation

| Point of Interest | Watershed Area (acres) | Long-Term Average Annual Precipitation (in) | Estimated Seasonal Unimpaired Flow (af) | Seasonal Diversions of Record Senior to Application (af) | Seasonal Diversions of Record Including Application (af) | C.F.I.I. (%) |
|---|---|---|---|---|---|---|
| *USGS Gage No. 11472200 (Outlet Creek gage)* | *103,657* | *49.82* | *150,777* | -- | -- | -- |
| *USGS Gage No. 11472160 (Willits Creek Gage)* | *2,364* | *49.82* | *5,358* | -- | -- | -- |
| 1 | 3,146 | 49.82 | 7,130 | 433 | 718 | 10.1% |
| 3 | 4,715 | 49.82 | 10,687 | 705 | 990 | 9.3% |
| 4 | 6,320 | 49.82 | 14,324 | 707 | 992 | 6.9% |
| 5 | 103,657 | 49.82 | 150,777 | 3,221 | 3,506 | 2.3% |